The SNR thresholds can also be changed dynamically by the mobile switching center that is connected to the base station. The mobile switching center connects the base station to the public switched telephone network (PSTN) and provides the switching functions required to pass data between the PSTN and the base station. If the base station is receiving from the mobile a signal that has a higher bit error rate than normal, the mobile switching center instructs the base station to increase the SNR threshold in the table for that mobile at that particular data rate.

In an alternate embodiment, the four power control commands are encoded in three bits of the frame. For example, the four threshold values define five possible SNR comparison outcomes. The first power control bit determines whether the received SNR exceeds the target level for 9.6 kbps. The remaining two bits use a binary encoding to indicate to which of the four lower levels the received SNR correlates.

In another embodiment, only two bits are used to control the mobile's transmitter power. This is accomplished by time sharing one of the bits between three of the thresholds. In this alternate embodiment, the first of two power control bits in each power control group are defined as in the preferred embodiment, i.e., transmit a "turn up" command if the received SNR exceeds the target SNR for 9.6 kbps and a "turn down" command otherwise.

In this alternate embodiment, the second of the two power control bits are time shared by every other bit signifying whether or not the received SNR exceeds target SNR for 4.8 kbps. The even numbered power control bits would alternately signify whether or not the received SNR exceeds the target SNR threshold for the 2400 and 1200 bps data rates. For example, in the sixteen power control groups of a data frame, the first, third, fifth, seventh, ninth, eleventh, thirteenth, and fifteenth would transmit a bit determined by whether or not the received SNR exceeds the SNR threshold for the 4800 bps data rate. The second, sixth, tenth, and fourteenth bits transmit a bit determined by whether of not the received SNR exceeds the SNR threshold for the 2400 bps data rate. The fourth, eighth, twelfth, and sixteenth bits transmit a bit determined by whether or not the received SNR exceeds the SNR threshold for the 1200 bps data rate.

In this alternate embodiment, the mobile, knowing the bit transmission rate it used to transmit the frame, interprets the received power control commands accordingly. For example, during transmission of a 9600 bps data frame, the second power control bit in each pair is ignored. During transmission of a 4800 bps data frame, the mobile ignores the first of each pair of bits in each power control group and obeys the second bit of the odd numbered pairs. The operation is similar for the 2400 and 1200 bps data rate cases.

In yet another embodiment, the base station uses two SNR thresholds for the 9600 bps rate, one just slightly above the target SNR threshold and one set slightly below the target SNR threshold. Obviously, the received SNR cannot be simultaneously above the threshold for 9600 bps and below the threshold for one of the three other data transmission rates. Due to the possibility of receiving the power control bits in error, the mobile could receive a pair of power control bits corresponding to such a situation. In this instance, the mobile should ignore this pair of bits since it is generally not possible to determine which of the two bits in the pair is in error. This embodiment, therefore, enables the sending of a "no change" power control command for the 9600 bps data rate.

If the received SNR exceeds the higher threshold, a "turn up" command is sent in the first of the pair of control bits in a power control group. If the received SNR is lower than the lower 9600 bps threshold, then a "turn down" command is sent.

The second bit of the power control group contains a "turn down" command unless the received SNR is lower than the appropriate threshold for a lower bit rate. If the received SNR falls between the upper and lower thresholds for 9600 bps, a "turn down" command is sent in the first command bit and a "turn up" is sent in the second bit. The mobile assumes that an error occurred in reception of the power control bits or assumes that a "no change" is being sent. In either case, the mobile does not change its transmitted power in the subsequent power control group time interval. This embodiment is useful in reducing the peak-to-peak fluctuation of mobile transmitter power when the power is adjusted very close to the target SNR. This reduces noise contributed by the mobile to other mobiles in communication with this particular base station.

In yet another alternate embodiment of the closed loop power control process of the present invention, a single power control bit is transmitted per power control group. In this embodiment, the odd numbered power control groups transmit a power control bit determined by the 9600 bps SNR threshold. Every other even power control group transmits a power control bit determined by the 4800 bps SNR threshold. The remaining even power control groups split between transmitting a bit determined by the 2400 bps SNR threshold and the 1200 bps threshold. For example, the first, third, fifth, seventh, ninth, eleventh, thirteenth, and fifteenth power control groups transmit a bit determined by the 9600 bps SNR threshold comparison. The second, sixth, tenth, and fourteenth bits transmit a bit determined by the 4800 SNR threshold comparison. The fourth and twelfth bits transmit a bit determined by the 2400 bps SNR threshold comparison. The eighth and sixteenth bits transmit a bit determined by the 1200 bps SNR threshold comparison. This technique reduces the number of power control bits transmitted on the base station to mobile link at the expense of reducing the rate of control bits by a factor of two, possibly resulting in greater error in closed loop power control in a high dynamic environment.

Still another embodiment of the closed loop power control process of the present invention relies on a predetermined pattern of thresholds, corresponding to different possible data rates. This process starts by the mobile or base station establishing the predetermined pattern of data rates. This pattern does not have to be evenly balanced but can be a function of expected data rates. A typical pattern looks like the following: 9600, 1200, 2400, 4800, and 14,400. This established data rate pattern is subsequently referred to as the assumed data rate pattern.

The assumed data rate pattern is then made known to both the mobile and the base station at some point, such as at call set up. If the mobile initiated the assumed data rate pattern, the mobile communicates the pattern to the base station and vice versa.

Using the assumed data rate pattern, the base station demodulator applies different energy thresholds to each power control group of received energy in determining the proper power control decision for each power control group. A typical example of an energy level threshold for each data rate is 9000 for 9600 bps, 6000 for 1200 bps, 3000 for 2400 bps, 1000 for 4800 bps, and 8000 for 14,400 bps.

The base station compares the energy of the incoming signal and guesses the data rate based on this energy level.